

CALIFORNIA DIVISION OF MINES AND GEOLOGY

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SUPPLEMENT/TO FAULT EVALUATION FEB-72

January 30, 1979

1. Name of fault

Elsinore fault zone, segment from Lake Elsinore to Prado Dam,  
Riverside County.

4. Aerial photography reference list

Designation: Fairchild C-1740  
Date: September 19, 1931  
Type: Black and white, vertical stereo  
Scale: 1:12,700  
Coverage: vicinity Corona, CA. Includes Chino and Elsinore faults  
in Prado Dam and Corona South quadrangles.  
Availability: Fairchild aerial photography collection, Geology Dept.,  
Whittier College, Whittier, CA.  
(This photo set, being the oldest, shows the scarp of  
the Chino fault between Prado Dam and Mabey Canyon  
more clearly than any other set).

Designation: Fairchild C-5928  
Date: July 8, 1939  
Type: black and white, vertical stereo  
Scale: 1:4,800  
Coverage: Vicinity of Prado Dam.  
Availability: Fairchild aerial photography collection, Geology Dept.,  
Whittier College, Whittier, CA.

Designation: Fairchild C-11730  
Date: September 9, 1947  
Type: black and white, vertical stereo  
Scale: 1:13,800  
Coverage: Irregular coverage at the vicinity of Prado Dam and  
near the northwestern end of Lake Elsinore.  
Availability: Fairchild aerial photography collection, Geology Dept.,  
Whittier College, Whittier, CA.

Designation: AXM  
Date: 1953  
Type: black and white, vertical stereo  
Scale: 1:22,000

Coverage: Western Riverside County, including the Chino and Elsinore faults.

Availability: California Division of Mines and Geology, Los Angeles District Office.

Designation: Fairchild C-22280  
Date: 1955  
Type: black and white, vertical stereo  
Scale: 1:7570  
Coverage: western Riverside County, Alberhill, Lake Mathews, and Corona South quadrangles; part of Elsinore fault zone.

Availability: Fairchild aerial photography collection, Geology Dept., Whittier College, Whittier, CA.

Designation: Fairchild C-22867  
Date: March 23, 1957  
Type: black and white, vertical stereo  
Scale: 1:43,000  
Coverage: Vicinity of Lake Elsinore, Riverside County.

Availability: Fairchild aerial photography collection, Geology Dept., Whittier College, Whittier, CA.

Designation: GSJ  
Date: January 15, 1975  
Type: black and white, vertical stereo  
Scale: 1:27,000  
Coverage: one line along Chino and Elsinore faults, Riverside County.

Availability: California Division of Mines and Geology, Los Angeles District Office.

#### 6 & 7. Aerial photo interpretation and field observations

This part of the study included the preparation of an aerial photo interpretation map (figure 5), a ground check of numerous localities along the fault zone, and discussions with Hal Weber, Earl Hart, and Richard Saul, all geologists with the California Division of Mines and Geology. The map (figure 5) is derived from what is visible on the aerial photography, and that includes only 2 categories of data: geomorphic features and vegetational features. The faults are shown, by the solid, dashed, and dotted lines, where I believe the faults to be. Strictly speaking, the faults of course cannot

actually be seen in the photos. Annotations and other symbols indicate the features that I observed and used as my basis for determining the location of the fault traces. Obviously there are many more fault traces in the area than are shown on figure 5. I have shown only those faults where the photo evidence is fairly clear for the existence and location of the fault trace; this restricts my mapping to those traces where movement has been recent enough to leave geomorphic features that are still fairly clear. I have added a linear reference grid to figure 5 to help in the identification of various localities along the fault zone.

My aerial photo study showed that the whole fault zone could be divided into a number of segments, with all of the fault trace in each segment showing a relatively uniform appearance in terms of types of features and their general youthfulness. Thus, when planning my field checking, I tried to visit a number of typical localities in each segment. This I essentially accomplished, but not as nicely as I had planned; in a number of places I could not gain access because of locked gates as far as 2 miles away from the fault zone. This land is all under private ownership and is mostly planted in citrus groves.

In the discussion that follows, I will discuss the fault zone in segments, starting at the northwestern end. All localities refer to figure 5, unless otherwise stated.

#### Chino fault segment

This segment is visible, on older photos, from the vicinity of Prado Dam southeastward to Mabey Canyon Wash. On the oldest photo set (Fairchild C-1740, 1931), which predates the beginning of construction of Prado Dam, a northeast-facing scarp offsetting on older alluvial surface is visible as

far to the northwest as map location 3.7. This scarp is also visible on younger aerial photography, but much of it has been destroyed by the construction of Prado Dam, a railroad track, and some highways. The scarp is 3 m to 5 m high, but exhibits a broad, gentle slope no steeper than about  $10^{\circ}$ . On November 6, 1978, Earl Hart, Richard Saul, and I inspected this fault where the Santa Fe Railroad tracks pass through the scarp in a deep cut (location 5.0). I observed evidence of faulting in older alluvium where the railroad cut passed through the scarp. The apparently offset strata suggest reverse faulting, with the fault plane dipping  $60^{\circ}$  to  $70^{\circ}$  to the southwest. I believe that the faulted alluvial surface is considerably older than Holocene age because of the amount of soil development and the amount and character of erosional modification. Also, the low angle of the scarp suggests that most or all of the vertical offset along the fault occurred before Holocene time. I see no evidence for strike-slip offset along this segment of the Chino fault.

To the southeast the scarp ends at Wardlow Wash, and the fault trace presumably passes beneath the modern alluvium along the bottom of the wash. I see no specific evidence for the fault trace along the floor of the wash. Farther to the southeast (locality 7.7) the wash trends off to the south and a northeast-facing scarp is again apparent, exactly in line with the scarp described above. Here the scarp forms the offset of the same older alluvial surface as described above, but the scarp is only 1 m to 2 m high. Locally, the scarp has been washed out by small drainages that cross it (as at locality 8.8). Farther to the southeast the scarp becomes very low and at locality 10.6 the sense of offset reverses. From locality 10.6 to 11.3 the older photos show a very low southwest-facing scarp, less than 1 m high.

The line of scarps just discussed, extending from locality 7.7 to 11.3, appears to be the same age as the scarp farther to the northwest near Prado Dam. To the southeast of locality 11.3 I see no clear evidence for the Chino fault. There is, however, a north-south-trending eroded scarp just south of Mabey Canyon (between localities 11.7 and 12.6). This scarp may have been formed by erosion along the outwash of Tin Mine and Hagador Canyons, but I am more inclined to believe that it is fault generated along a fault segment that connects the Chino fault trace with the Main Street fault segment. In either case, the scarp is maturely dissected to the point that it is unlikely that it was formed in Holocene time.

Both Weber (1977) and I mapped the Chino fault, between Prado Dam and Mabey Canyon in essentially the same place. There is a slight difference in our locations, but I think we were observing the same topographic evidence. I see no evidence for the Chino fault trace as mapped by Gray (1960) and Lamar (1959). They each show an inferred trace to the northeast of the fault as shown by Weber and myself. Weber (1977) shows the Chino fault continuing in a nearly straight course to the southeast beyond Mabey Canyon Wash. I see no clear evidence for the Chino fault in this area. In the vicinity of Mangular Avenue Weber indicates evidence for Holocene activity. Specifically, his evidence is the observation of a vegetational lineament. I do not see this on any of the aerial photo sets. In any case, I do not interpret vegetational lineaments as being strong evidence for Holocene fault movement, although Weber seems to almost always make that interpretation.

#### Tin Mine fault segment

The system of loosely-connected fault traces mapped by Weber (1977) as the Tin Mine fault (see figure 4) are not apparent on the aerial photography.

That is not to say that I am unable to see any evidence in the photos for these fault traces, but rather that there is no appearance of recent fault movement, and it is not apparent in the photos that there is a through-going fault zone as mapped by Weber. I am quite willing to accept Weber's interpretation that this fault segment has not been active as recently as Holocene time.

Main Street fault segment

I am not able to follow this fault, in the aerial photos, to the northwest of Tin Mine Canyon (location 13.0). The discussion given for the Tin Mine fault segment applies in the same manner to this part of the Main Street fault segment. To the southeast, from Tin Mine Canyon to Joseph Canyon (location 13.6 to 21.3), I see the same general evidence and plot the fault in nearly the same place as Weber (1977). However, between Main Street Canyon and Eagle Canyon (location 17.4 to 19.7), the aerial photo evidence is too vague for me to plot the location of the fault trace. The parts of the Main Street fault segment that I have mapped are characterized by 25 m to 35 m high northeast-facing scarps that are incised all the way to the base by the medium and larger sized drainages. At the top of this scarp there are remnants of a very old alluvial surface. I see some evidence of right-offset of some of the drainages that cross the scarps, but, as evidence for right-lateral movement along the fault, this is inconclusive. I observe a low, northeast-facing scarp, about 1 m high, in what I would call "younger older alluvium". This surface, and the scarp, could be as young as Holocene age (location 17.1). Weber (1977) indicates Holocene offset at one place along the Main Street fault segment, at his location H-13 b (see figure 4). On p. 87 of his report, Weber says, "Fault trace apparently cuts youthful

alluvial sediments". I see no evidence for this either in the photos or on the ground.

A problem with the evaluation of the location and recency of movement along this fault segment is that most of the fault trace has been covered with citrus groves. Most of the very specific fault evidence, if any existed, was destroyed when the land surface was prepared for the orchards.

#### Eagle fault segment

I am not able to follow this fault in the aerial photos to the northwest of Joseph Canyon (location 21.0). The discussion given for the Tin Mine fault segment applies in the same manner to this part of the Eagle fault segment. Weber uses the name "Eagle fault" southeastward to Brown Canyon (location 30.5), and beyond that point refers to the fault as the "Glen Ivy North fault". I will use the same nomenclature. Along the part of the Eagle fault that I have mapped (location 21.0 to 30.5), the terrane on both sides of the fault is fairly well dissected. However, to the southwest of the fault the terrane rises abruptly in general elevation; this fault, in this area, forms the northeastern range front boundary of the Santa Ana Mountains. There are no obvious, youthful-appearing, scarps along this fault segment, but, except where the fault passes beneath modern washes, the trace generally traverses steep slopes. What I do see are abundant right-offset drainages, right-offset ridge spurs, beheaded drainages, and several hillside benches. The topography strongly indicates that the more recent movements along this segment have been mainly right-lateral in sense, with a lesser component of vertical offset, southwest side upthrown

Weber (1977) does not indicate Holocene offset along this fault segment. However, based on the general youthfulness of appearance shown by the geomorphic features, I think it probable that Holocene movement has occurred. I see no evidence to deny this, such as unfaulted older alluvial

surfaces.

Weber shows a series of fault traces to the northeast of the Eagle fault between Eagle and Brown Canyons (location 21.0 to 30.5). I see vague indications of these faults in the photos, but no evidence that there have been movements along these traces as recently as the Eagle fault trace. Weber indicates Holocene offset along one of these traces, this location H-33 (see figure 4). He bases this on "vegetation growth along the fault trace in younger alluvium".

Glen Ivy North fault segment

Weber (1977) uses this name for the southeastward continuation of the Eagle fault. He applies the name from Brown Canyon southeastward to a point several kilometers beyond Lake Elsinore (location 30.5 to 80.0). I recognize specific evidence for the fault trace, in the photos, only from Brown Canyon southeastward to the mouth of Rice Canyon (location 30.5 to 53.4). In general, I plot the fault trace in about the same place that Weber (1977) has mapped it. There are two significant exceptions. To the northeast of Glen Ivy Hot Springs there is a section, about 2 km long, where I do not see evidence for the location of the fault (location 34.8 to 39.2). This area is covered by late Holocene and modern alluvium that has washed out of several large drainages to the south. It appears that any Holocene fault features would have been destroyed by this action. I do not argue that the Glen Ivy North fault does not exist in this area or that it has not been active during Holocene time; only that there is presently no surface expression of the trace.



Immediately to the southeast, Weber mapped the location of the fault at the base of a prominent southwest-facing scarp (location 39.2 to 41.3). I disagree with his location of the fault. The scarp was probably originally generated by faulting; the beheaded drainages at the top are fairly strong evidence for this interpretation. However, the outwash from Mayhew Canyon and some smaller drainages to the south impinges directly against this scarp, and I believe that erosion has caused the scarp to retreat as much as 100 m to the northeast from the position of the fault trace. Thus, I show an inferred (dotted) fault on figure 5, at a position somewhat southwest of the scarp. *Weber (personal communication, January 1979) said that he had no specific evidence for locating fault at present scarp.*

Along that part of the Glen Ivy North fault that I have mapped, there is much evidence for movement that is probably as recent as Holocene time. Faulting has offset alluvial surfaces that are probably as young as Holocene age, at locations 30.5, 45.5, and 46.3. In each of these places the apparent sense of offset is southwestern side upthrown, and this may represent the most recent sense of offset along this fault segment. There are many areas of offset of older alluvial surfaces along this segment; the apparent vertical sense of offset is mixed. Other evidence for relatively recent fault offset includes beheaded drainages, right-deflected drainages, right-offset canyon walls and ridge spurs, linear valleys, and closed depressions. The closed depressions (locality 34.2) are especially indicative of Holocene faulting because, at their location, they are subject to relatively rapid filling by the outwash of Bixby and Anderson Canyons. Farther to the southeast, between locations 49.0 and 53.3, I see very obvious rejuvenation of downcutting of the drainages upstream (southwest) of the fault. This suggests that there has been significant Holocene offset in the vertical sense,

southwestern side upthrown, along this part of the fault.

Earl Hart, Richard Saul, and I examined the road cracks in Lawson Road that were discussed in the initial FER-72. These cracks (location 34.0) appear to overlie the contact between original ground and filled ground. The configuration of the cracks was not what would be expected if the Glen Ivy North fault passed beneath the road at this place and there was ongoing creep in a vertical or right-lateral sense. We concluded that the road cracks were caused by improperly compacted fill beneath the pavement.

To the southeast of Rice Canyon (location 53.4) I see no specific evidence for the location of the Glen Ivy North fault. Between the mouth of Rice Canyon and Lake Elsinore, the entire area is an actively aggrading alluvial apron. It is quite possible that the rate of alluviation is sufficient to have destroyed or buried any ground rupture features that may have formed during Holocene time. Weber (1977) shows the Glen Ivy North fault as arcing to the northeast and passing along the base of a prominent scarp that occurs opposite the mouth of Rice Canyon (location 53.7 to 55.4). I interpret this scarp as being of erosional origin, generated by the impingement of the outwash of Rice Canyon against the higher ground to the northeast. I do not believe the scarp was formed by the Glen Ivy North fault or a northeasterly offshoot of that fault as Weber's mapping could be interpreted. Weber indicates evidence for Holocene offset at his location H-65 (see figure 4) at a stream channel just west of the scarp. His interpretation is based on "vegetational effects". I see vague indications, in the photos, for these fault traces to the <sup>north-</sup>west of Weber's H-65 locality but they do not in any way show evidence for recent offset.

At 2 places along the Glen Ivy North segment I observed short branch faults that are manifested by scarps that may be as young as Holocene age (locations 48.0 and 52.0).

#### Glen Ivy South fault segment

This fault occurs along the southwestern side of Temescal Valley, and appears to be the range front bounding fault of the Santa Ana Mountains in this area. I recognize good photo evidence for the location of this fault between locations 33.8 and 40.6. Weber maps traces of this fault considerably farther to the northwest and southeast. The range front rises very abruptly to the southwest of the fault. The fault, in the photos, is characterized by steeply faceted spurs, northeast-facing scarps, strong vegetational lineaments, and notched spurs. On the ground, I examined the fault at two localities. Just west of Glen Ivy Hot Spring (location 35.0), along the base of one of the more prominent faceted spurs, I observed much irregular topography with local benching and abrupt steepening. These features do not appear to be caused by landsliding. I interpret them as being caused by Holocene faulting along the base of the faceted spur. Near the mouth of Mayhew Canyon (location 40.0), I observed a northeast-facing <sup>in older alluvium</sup> scarp about 2.0 m high with a maximum slope angle of  $35^{\circ}$ .

#### Willard fault

Weber (1977) shows the Willard fault as a string of fault trace segments that lie along the foot of the Elsinore Mountains along the southwestern side of the Elsinore through. The Willard fault represents the presumed boundary between the Elsinore trough and the Elsinore Mountains. I was unable to find any specific evidence for a surface trace of this fault. At several

localities (see figure 4) Weber shows a ball-and-chain symbol for a scarp or an offset surface. I examined these localities, both on the photos and on the ground, and found no such features.

#### Wildomar fault

Weber (1977) shows the Wildomar fault as extending southeastward from the western end of Lake Elsinore. I have been unable to find any surface evidence for the existence or location of the fault to the northwest of Rome Hill (location 70.2). To the southeast of Rome Hill, there is good surface evidence for the fault for at least 6 km. The principal surface evidence consists of 2 general scarps: one which lies to the northwest of Corydon Road (location 74.3) and faces the northeast, and the other which lies to the southeast of Corydon Road and faces the southwest. In each case there is a group of hills on the up-thrown side of the scarp, and each group is almost the same as the other in length along the fault. Viewed on aerial photos, the 2 groups of hills, on opposite sides of the fault, appear to be the right-laterally-offset halves of what was originally one hill. Weber maps both of these groups of hills as being underlain by the early Pleistocene Pauba Formation. Thus, my interpretation is that these hills are in fact the offset halves of what was once one hill. That accounts for the difference between my mapping of this part of the Wildomar fault and that of Weber (1977). There are some geomorphic features just southeast of Corydon Road, including a swale and a bench (figure 5), that support my interpretation.

Weber (1977) indicates Holocene offset (his locality H-76) along a fault segment mapped by Engel (1959) as the North Elsinore fault. This locality is about 2.5 km north of the town of Elsinore. Weber (personal communication, 1978) said that his inclusion of this locality in his report is

based on Engel's map and description, and that he, himself, was unable to confirm the evidence presented by Engel. I, too, was unable to find any evidence for faulting in that area.

8. Conclusions

I conclude that the segment of the Chino fault considered in this report has not been active during Holocene time. The scarps, the only specific geomorphic evidence for this trace, are preserved only on older alluvial surfaces, and show considerable erosional modification. I have been unable to find any evidence for Holocene offset in the vicinity of Mabey Canyon as indicated by Weber (1977).

I conclude that the Tin Mine fault segment and the Main Street fault segment probably have not been active during Holocene time. I see no offset of surfaces that are probably as young as Holocene. The geomorphic features associated with these traces, primarily high, eroded scarps, show no evidence of rejuvenation of offset during Holocene time. I have not been able to confirm the evidence given by Weber (1977, his locality H-13 b) for Holocene offset at that place. I see one piece of evidence for possible Holocene faulting in the form of a low scarp at location 17.1. I think this evidence is too limited and inconclusive to justify the establishment of a zone along this fault segment.

I conclude that the Eagle fault segment is not active to the northwest of Joseph Canyon (location 21.0). Geomorphic representation of this part of the trace is very weak or lacking. Weber (1977) found no evidence for Holocene activity along this part of the Eagle fault.

I conclude that Holocene offset has probably occurred along the Eagle fault segment to the southeast of Joseph Canyon. This fault trace lies mainly in pre-Quaternary rocks or very old alluvium. The only exceptions to this are the places where it crosses the modern washes. The trace lies almost entirely within steep, actively eroding terrane. Weber (1977) recognized no specific evidence for Holocene activity along this part of the Eagle fault. However, I am impressed with the obvious consistency of right-deflected drainages, plus several hillside benches and offset ridge spurs. Considering the rapid rate of erosion in this area, I would not expect these features to survive as well as they have except if the offset has occurred in Holocene time.

I conclude that the Glen Ivy North fault, to the northwest of Rice Canyon (location 53.4), has been active during Holocene time. The reasons have been given in section 6 & 7 of this report. There is much evidence for offset that has almost certainly occurred during Holocene time. Also, it is probable that Holocene activity along the Glen Ivy North fault has extended to the southeast of Rice Canyon, perhaps as far as some point beneath Lake Elsinore. However, it is clear that active late Holocene alluvial fan deposition in this area has destroyed or buried any surface features that the faulting may have generated.

I conclude that the Glen Ivy South fault segment has been active during Holocene time, between locations 33.8 and 40.6. The geomorphic evidence at several sites, as discussed earlier in this report, indicates that the most recent offsets almost certainly occurred during Holocene time.

I conclude that the Willard fault has not been active during Holocene time. I cannot even find specific evidence for the location of the fault.

I conclude that the Wildomar fault segment has been active during Holocene time. To the southeast of Rome Hill there is good geomorphic evidence for such recency of offset. To the northwest of Rome Hill the erosional and depositional processes associated with the San Jacinto River and Lake Elsinore, have destroyed or buried the surface features that may have been generated by faulting during Holocene time. It is almost certain that Holocene offset along the Wildomar fault has extended to the northwest of Rome Hill, probably to some point beneath Lake Elsinore. I cannot find any surface evidence for either the location or recency of activity of this fault (as indicated by Weber, 1977) to the northwest of Lake Elsinore.

There are several localities along the Elsinore fault zone where Weber (1977) indicates Holocene activity along local fault segments that occur separately from the main fault segments. I have discussed these localities in section 6 & 7 of this FER, and in each case rejected either the evidence or the interpretations. Thus, I conclude that none of the other numerous small fault trace segments, mapped by others along this part of the Elsinore fault zone, are active.

9. Recommendations

I recommend that special studies zones be established along all of the fault segments, or parts of segments, that I have concluded to be active or probably active. I recommend that the individual traces that are zoned be the ones shown on figure 5, but that the depiction of the traces that are shown on the SSZ maps be taken from the corresponding traces on Weber's (1977) map. Weber's mapping is based on much more detailed on-the-ground work than

mine (figure 5). I disagree with Weber's mapping in a few localities (as discussed in section 6 & 7 of this report). In those cases, I recommend the fault be depicted on the SSZ map as I have shown it on figure 5.

Regarding the Glen Ivy North fault, I recommend that the special studies zone be extended across that part of Temescal Valley where there is no surface evidence for the fault (location 35. to 39.). At Rice Canyon (location 53.7) I recommend that the zone be extended a short distance *as shown on figure 5,* to the southeast, with the fault shown with a queried, dotted symbol. I recommend that the zone along the Wildomar fault be extended to the north-*as shown on figure 5,* west about 0.5 km beyond Rome Hill, again using a queried and dotted fault symbol.

10. Investigating geologist's name; date

*Drew P. Smith*

DREW P. SMITH  
January 30, 1979



mine (figure 5). I disagree with Weber's mapping in a few localities (as discussed in section 6 & 7 of this report). In those cases, I recommend the fault be depicted on the SSZ map as I have shown it on figure 5.

Regarding the Glen Ivy North fault, I recommend that the special studies zone be extended across that part of Temescal Valley where there is no surface evidence for the fault (location 38. to 39.). At Rice Canyon (location 53.7) I recommend that the zone be extended about one kilometer to the southeast, with the fault shown with a queried, dotted symbol. I recommend that the zone along the Wildomar fault be extended to the northwest about 1.5 km beyond Rome Hill, again using a queried and dotted fault symbol.

10. Investigating geologist's name; date

*David P. Smith*

DAVID P. SMITH  
January 30, 1979

*I concur with all recommendations for zoning with the exception that I have reservations on the zoning the projected traces of the Glen Ivy north fault to the SE and the Wildomar fault to the NW. Why not use Weber's projections if a projection must be used?*

*ELM*

*2/26/79*